



A.D. 1822 N^o 4685.

S P E C I F I C A T I O N

OF

WILLIAM BRUNTON.

FIRE GRATES.

L O N D O N :

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Fire Grates.

BRUNTON'S SPECIFICATION.

TO ALL TO WHOM THESE PRESENTS SHALL COME, I, WILLIAM BRUNTON, of Birmingham, in the County Warwick, Engineer, send greeting.

WHEREAS His most Excellent Majesty King George the Fourth did, by His Letters Patent under the Great Seal of that part of the United Kingdom of Great Britain and Ireland called England, bearing date at Westminster, 5 the Twenty-sixth day of June, 1822, in the third year of His reign, give and grant unto me, the said William Brunton, my exors, admors, and assigns, His especial licence, full power, sole privilege and authority, that I, the said William Brunton, my exors, admors, and assigns, during the term of years therein mentioned, should and lawfully might make, use, exercise, and vend, 10 within England, Wales, and the Town of Berwick upon Tweed, my Invention of “CERTAIN IMPROVEMENTS UPON FIRE GRATES AND THE MEANS OF INTRODUCING COAL THEREON;” in which said Letters Patent there is contained a proviso that if I, the said William Brunton, shall not particularly describe and ascertain the nature of my said Invention, and in what manner the same is to be performed, 15 by an instrument in writing under my hand and seal, and cause the same to be inrolled in His Majesty’s High Court of Chancery within six calendar months next and immediately after the date of the said Letters Patent, that then the said Letters Patent, and all liberties and advantages whatsoever thereby granted, shall utterly cease, determine, and become void, as in and by the same 20 (relation being thereunto had), will more fully and at large appear.

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NOW KNOW YE, that in compliance with the said proviso, I, the said William Brunton, do hereby declare that the nature of my said Invention, and the manner in which the same is to be performed, are particularly described and ascertained in the following description thereof, (that is to say) :—

My said improvements consist in conveying the fire progressively through 5 the furnace by the motion of the grate bars, and by the same means depositing the clinkers or other incombustible matter into a receptacle at the further end of the furnace, and I intend that grates constructed after this manner shall be designated and known by the appellation of peristaltic grates; secondly, in introducing the coal upon the fire and regulating the same by means herein- 10 after described. In describing my said improvements on fire grates I shall for the sake of perspicuity divide the length of the furnace, of which my said improved grate is the floor, into three distinct parts; first, that next to the fire door or front of the furnace, which I call the close or dead part, upon which the coals is introduced; secondly, the open or fire part, upon which the 15 combustion of the fire is carried on; thirdly, the exit part, upon which are conveyed the clinkers and other incombustible matter into a close receptacle inclosed at the farther end of the ash-pit, over which the exit end of the grate bars are made to project; at the bottom of the said receptacle there is an iron door closely fitted, by which it is occasionally emptied. I also make the front 20 of the bridge wall of the furnace to project about two or three inches over the exit ends of the bars, and about three inches above, thus leaving an opening for the discharge of the clinkers and other incombustible matter. The above three parts I construct upon one length of bars, which I shall designate in the following Specification grate bars, or for brevity, the bars. The portion of the 25 grate bars which form the floor of the close part of the furnace I make from eighteen to twenty-four inches long, with parallel and flat sides, so as to leave the least practicable interstice between them consistent with their being individually loose and moveable. The portion of the grate bar which forms the opening or fire part of the furnace I form similar to the grate bar in common 30 use, leaving an interstice between the bars of sufficient width for the admission of air as well as the discharge of dust, the length varying with the required efficiency of the furnace. The third or exit portion of the bars I make from nine to twelve inches long, making the sides parallel and flat, leaving as little space betwixt the bars as is practicable. In moving the fire progressively 35 through the furnace, first, I cause each alternate grate bar to rise simultaneously above the common or mean surface of the grate bars, and while thus raised and bearing the chief weight of the fire, to move onward in the direction I intend the fire to be conveyed, and when they have arrived at the end of

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their range to fall below the other bars or the said mean surface of them, and while thus depressed to move in a contrary direction toward the other extremity of their range, preparatory to a repetition of their action. But to be more perspicuous, I will suppose the grate bars to be numbered 1, 2, 3, 4, 5, 6, 7, 8, 5 9, 10, and so forth. I fix, as in the usual manner, the bars N° 1, 3, 5, 7, 9, and so forth, and to the bars 2, 4, 6, 8, 10, and so forth, I communicate the motion as above described; or, secondly, I cause each series of alternate bars to move simultaneously in the manner already described. Thus I cause the bars N^{os} 1, 3, 5, 7, 9, and so forth, to rise above the common surface, and to move 10 onward, whilst the other series, namely, N° 2, 4, 6, 8, 10, and so forth, fall and move in the contrary direction, each series thus maintaining a reciprocal action on the fire. Thirdly, I also produce the same progressive movement of the fire by inclining the grate bars about one in seven lower toward the end to which I wish to convey the fire, and then communicate to each bar, or to 15 each alternate bar, a reciprocating motion either in the direction of its own length or in the direction of a right angle to the surface of the grate, or of any intermediate angle between the surface of the grate and the perpendicular thereto on the side toward the lower end of the grate bars. Fourthly, I also produce the progressive movement of the fire by a combination of the motions 20 already described, and cause the upper end of the bars (being laid sloping as in the third case) to partake of the motion, as described in the first and second cases, namely, alternately to rise above the common surface and move onward with the fire, whilst the other end of the said bars lie upon and slide with a reciprocating motion in the direction of their own length over a fixed bearer.

25 Having specified the motions which I communicate to the grate bars in order to obtain a progressive movement of the fire, I shall now describe the means by which I produce the several motions, which means I generally use and recommend, but wish to be understood as not confining myself exclusively to them. To produce the first motion I construct two or more bearers extending 30 the whole length of the grate, moveable round their own axis, which I call eccentric or revolving bearers, or for brevity, bearers, having at proper intervals, suited to the thickness of and width between each alternate grate bar, circular bearers having from half an inch to one inch eccentricity with the axis of the bearer; these bearers I connect by wheels, namely, a wheel of equal 35 diameter on each bearer, and an intermediate wheel between, so that the said eccentric bearers revolve in the same direction and in the same time, and having the eccentric circular bearings for the grate bars in the same position. The said bearers have gudgeons extending from their ends, and are thereby supported upon the side walls of the ash-pit under the open or fire part of the

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grate bars, and each alternate moveable bar having proper projections, with curved feet, suited to their respective eccentric circular bearings, rest thereon. The eccentric bearers being turned round by the power of a steam engine, or any other convenient power, will communicate to the moveable alternate bars the required motion, that is, by the eccentricity of the circular bearings the bars 5 resting thereon will be raised above the fixed bars, move onward in the direction in which the eccentric bearers are turned, at the end of their range fall below the fixed bars, upon which they deposit the fire, and while depressed return to repeat their action upon the fire. I produce the second motion by constructing two or more eccentric or revolving bearers, suited to the width of the 10 grate and similar to those used in producing the first motion, but having at proper intervals, suited to the thickness of and width between each grate bar, circular bearings having from one quarter to three quarters of an inch eccentricity with the axes of the bearer, these bearing having their eccentricity alternately on opposite sides of the centre of the bearer; the said revolving 15 bearers I connect by wheels, revolve in the same direction and time, and the eccentric bearings disposed in the same order as already described for those of the first motion, and the grate bars resting upon their respective bearings; the said revolving bearers being turned round in the direction in which it is intended to move the fire, one series of alternate bars will rise up and support the fire 20 and move onward, whilst the other series depressed will move in the contrary direction. In producing the several modifications of the third motion I construct one or more revolving bearers, similar to those already described as suitable to the second motion, but the grate bars, instead of resting wholly upon the revolving or eccentric bearers, are made to rest or slide, partly or 25 altogether, upon fixed bearers. The surface upon which the bars slide or move, and also the face of those parts of the bar which rest or slide thereon, I make in the same direction in which it is intended the bar should be moved, and also the bars do not rest upon the revolving bearer with curved feet, (as in the first and second motion,) but are connected therewith 30 by two straight parallel cheeks attached to or cast with the said bars, at such distance from each other as is equal to the diameter of the circular eccentric bearings of the revolving bearer, and the said parallel cheeks are attached to the bar at such an angle or position as will suit the movement intended to be given, that is, they are placed at right angles to the intended line of motion, 35 and so long as to permit the eccentric bearings to revolve between them without communicating any other motion than that at right angles to the said cheeks; thus, if the motion is intended to be in the direction of the length of the bars, the surface of the fixed bearer, and also that of the part of the bar

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resting or sliding thereon will be paralel to the surface of the grate, and the cheeks cast upon the bar will stand at right angles to it. In producing the fourth motion, I construct one eccentric or revolving bearer as suitable to the second or third motions, and I also construct each of the grate bars with a
5 curved foot toward their upper end, suited to and resting upon the eccentric bearings of the revolving bearer, whilst the lower ends of the said grate bars rest upon a fixed bearer, over which they slide as the revolving bearer is turned round, and communicates to the higher end of the bars that motion (simular to the second,) by which the fire is progressively moved toward the lower end of
10 the grate. To prevent the admission of air below the bars whilst they are moved above and below the common surface of the grate upon the under edge of those bars which are thus lifted, and upon the dead or close part and exit part of the bar, I cast a tooth as wide as the parts of the bar to which they are attached, and about two inches in the other direction, and about six inches long, which
15 projects downwards into a trough extending from side to side of the grate, and is filled with sand or water, in which the said teeth are immersed, and work sufficiently deep to prevent the air passing under them when the bars are elevated; when the said tooth is used at the exit end of the grate the said sand or water trough rests upon the wall which forms the end of the open ash-pit,
20 and incloses the receptacle for the clinkers and scoria, and when the said tooth is used at the dead end of the grate, the said sand or water trough is carried by the side walls of the ash-pit and the space between it and the front of the furnace is inclosed either by an arch of brick or an iron plate the whole width of the ash-pit, and extending from the said trough to the front of the furnace,
25 to which I attach an upright plate, in which there is the fire door opening fitted with a door, also a small door at the bottom of the said front plate for cleaning under the close part of the bars; the said upright plate extends high enough to communicate to the roof of the furnace, and thus inclose the dead or close part of the grate bars, by which free access of air is excluded therefrom.
30 In the roof of the furnace, and nearly over the middle of the dead or close part of the grate bars I form a hole, having its length equal to the whole width of the grate, and about six inches wide (which I call the feeding hole), and is carried either perpendicular or sloping through the brickwork, or through a projecting part of the boiler, as may be found most convenient; the said feeding
35 hole, if sloping, should be made very smooth on the bottom, on which the coal in that case will slide. To the outer end of the said feeding hole I attach the feeding apparatus, either that of which the following is a description, but which is not new, or those which I shall afterward describe, which are new. I form a receptacle, in shape similar to the hopper of a corn mill, (which I call the fire

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feeder,) excepting that the bottom is made oblong, its length being equal to the width of the grate which it is intended to feed, and its width about nine inches; the apparatus through which the coal passes from the receptacle is on one of its sides and close to the bottom, and this aperture is adjusted to the size of the pieces of coal used by means of a sliding shutter, raised or lowered 5 as occasion may require, varying from two to five inches; the bottom of the said fire feeder is an iron plate about twelve inches wider than the lower orifice thereof, and inclined downward about one in six towards the side on which is the aperture for discharging the coal, and in the same direction it has a reciprocating motion by which the coal resting upon the said iron plate or bottom is 10 passed through the aforesaid opening in the side of the said fire feeder, and precipitated over the lower edge of the said plate into the said feeding hole. I communicate the said reciprocating motion to the bottom plate which moves through equal space at each end by a shaft extending the whole length of the sliding plate; near to the extremities of the said shaft I fix two levers of equal 15 length, to the ends of which by joints and rods I attach the said sliding bottom plate, which by the reciprocating motion of the said shaft and levers is moved in a direction transverse to the length of the said feeding hole and aperture in the bottom of the said fire feeder. In order to prevent any air from entering the furnace by the said feeding hole, I connect the said fire feeder to the said 20 feeding hole by a case which incloses the lower part of the said fire feeder with its moveable bottom plate, making a hole in the said case through which the said shaft, with its equal levers, is extended, in order that the necessary motion may be communicated thereto, by connecting the same with an engine or other convenient power. I construct a rectangular box of sheet or cast iron or other suitable 25 materials; I make the side thereof, from which the coal is discharged, as long as the width of the grate that it is intended to feed, its width varying from four to eighteen inches, its depth also varying generally from one foot six inches to five feet, according to the local circumstances of its situation, or to the quantity of coal it is required to hold; it is close at the bottom; the upper end 30 is open, by which it is filled, but is provided with a close, well fitted cover, to prevent the introduction of atmospheric air; the side from which the coal is discharged is moveable in the direction of its own plane and the depth of the box, being attached thereto by slides or rabbets, in which the said side moves and fits so closely as to prevent coal passing between it and the said box. The 35 box, which I call the coal receiver, or for brevity, the receiver, being thus constructed, filled with coal, and placed perpendicular or inclining towards the side which is moveable, the said moveable side is forced downward by the power of a steam engine or other convenient power; the coal will then be

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discharged by his own gravity from the receiver over the upper edge of the said moveable side as it descends ; when I apply this said coal receiver, I construct the feeding hole in a sloping direction, not more than forty-five degrees from perpendicular, through the brickwork of the flues, and connect the outer end thereof
5 with the sides and top of the said receiver, so that the coal discharged therefrom falls directly into the feeding hole, and is thereby conveyed to the grate, whilst the atmospheric air is excluded. I also in some cases fix what I have called in the above description the moveable side, and by the power of a steam engine or other convenient power, I elevate the receiver when filled with coal, by which
10 the coal is discharged over the upper edge of the said fixed side ; when I thus discharge the coal by elevating the receiver I make the fixed side wider than the receiver, and as much higher as the receiver is intended to be raised ; upon the open edges of the receiver in the direction of its height I fix slides which slide in corresponding rabbets or grooves upon the fixed side, and through
15 the said fixed side at the height of the receiver from the bottom I make an opening as wide as the receiver, and about seven inches high, through which the coal is discharged into the feeding hole, which is also connected to the fixed side, so as to exclude the air, and in order to prevent the undue admission of air into the receiver as it is raised its open side continues to slide against that
20 part of the fixed side which is above the said opening. I wish it to be understood that the above two last described modes of feeding the grate are new, and I consider as most applicable to furnaces consuming under ten bushels of coal per day, and in such cases, if local circumstances permit, I make the receiver sufficiently large to hold coal for one days consumption. No
25 competent engineer will find any difficulty in communicating from one steam engine or other power a simple rotary motion to the excentric bearers of the grate bars, which I make to revolve from three to six revolutions in five minutes ; nor will any engineer find difficulty in borrowing from any convenient power that which may be necessary to give the reciprocating motion to the
30 moveable bottom plate of the fire feeder, nor to convey such portion of power from any convenient source as will be necessary to lower the moveable side of the coal receiver, or to elevate the coal receiver in such time as will maintain the required intensity of the fire. But I shall describe methods of doing so which will be easily understood, and which I use, approve, and recommend.
35 I attach to the end of one of the eccentric bearers a bevel wheel with which I connect another bevel wheel upon an upright shaft, which extends above the boiler, to any convenient height, where I attach thereto a bevel wheel of about thirty inches diameter, into which runs a pinion of about five inches diameter, driven by and fixed upon a shaft extending from the engine or source of power.

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At some part of the line of communication I introduce the means of altering the speed at pleasure, either by two conical drums, or a series of pullies of various diameters, or any other well-known means of regulating the speed of a driven shaft; in order that the speed of the eccentric bearers may be suited to the nature of the coal, the intensity of the heat, or any other circumstance. 5
Upon the above-mentioned upright shaft having a bevel wheel at the bottom, and another of about thirty inches at the top, and being driven by the engine, I fix a cam or eccentric curve, which, being brought round by the revolution of the said upright shaft, may act against a lever connected by a rod and another lever to the said reciprocating shaft, extended 10 through the hole in the said case, having the two equal levers by which the sliding bottom plate of the fire feeder is moved in one direction, at the same time raising a weight connected with and sufficiently heavy to move the said plate back again in the opposite direction whenever the cam has ceased to act upon the said lever. In order to regulate the quan- 15 tity of coal introduced by each movement of the said sliding bottom plate, I cause the said lever to act against or fall upon a wedge which by moving longitudinally by being attached to the damper regulator (if there be one) will encrease or diminish the space through which the said sliding bottom plate moves, and thereby increase or diminish the quantity of coal introduced. In 20 applying the necessary motion to discharge the coal from the coal receiver, whether by lowering the moveable side or by elevating the receiver itself, having ascertained what quantity of coal it can contain, and also the quantity of coal needful to be consumed in any given time, say one hour, I communicate a motion from the upright or lying shaft (by which the eccentric bearers are 25 driven) to another shaft parallel thereto by the well-known means of two reversed conical drums and a leather strap, which is constrained by two guide rollers to run upon any opposite portions of the two drums, and thus afford means of accurate adjustment of speed. From this driven shaft I connect such a train of pinions and wheels or screw and wheel as will sufficiently reduce the 30 speed of a roller, round which I cause a chain to wind, the other end of which is attached to the moveable side of the coal receiver, or to the moveable coal receiver, as the case may be, by which means the coal will be discharged at any required speed within the range of the said conical drums; I also connect the said two guide rollers of the strap to the damper regulator in such a manner 35 that as the pressure of the steam increases, the guide rollers moving the strap between the said conical drums diminish the speed of the discharge of the coal, and vice versa. I sometimes apply the two last-described methods of introducing coal, which I state as new, to feed fires of the ordinary construction; and where

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there is no convenient power to be procured by which the receiver can be raised or the moveable side depressed, as already described, I in such cases attach a weight by a chain and pulley sufficiently heavy to discharge the coal from the receiver, which weight is wound up by means of a windlass of sufficient power
5 when the receiver is depressed or lowered preparatory to its being filled with coal. But to prevent the precipitate discharge of the coal I construct two bags, each of which I make somewhat longer than the space through which the said weight which discharges the coal is intended to move; the said bags I connect by their open ends to a division having a hole one quarter of an inch
10 diameter, through which sand may pass from one bag to the other. Through the said division and transversely with the said hole I make another hole or opening, through which I introduce a slide of brass or other suitable metal, having several holes of different area suited to the time in which a bag full of sand is intended to pass, and by moving the said piece of brass any of the
15 graduated holes may be brought to correspond with the said sand hole in the division, and by that means regulate the time of the discharge of sand from one bag into the other; the two bags, one of which being fill'd with sand or metallic powder such as is commonly used in what are called minute or hour glasses, thus connected by the divisions and transverse regulating slide, I enclose in a
20 case of sheet iron or other suitable materials corresponding with the size of the bags, and long enough to enclose both; a hole is made through the middle of the said case for the admission of the transverse slide having the graduated holes; the said case I suspend by two trunnions by the middle of its length in a suitable frame, so that it may be conveniently turned upside down and fixed
25 in a perpendicular position. This apparatus, which I call the sand regulator, I place under the said weight, which is made of such dimensions as to go within the said case and resting upon the upper bag filled with sand, or the said metallic powder is thereby supported and permitted to fall only as the sand or powder is permitted to escape into the lower bag; when this is done, and the
30 weight has followed the sand or powder, the coal will also be discharged from the receiver, which in order to be refilled must be depressed, and consequently the weight raised, and being drawn out of the said case of the sand regulator the lower bag being full of sand or powder is then turned up (analogous to the turning up of a sand-glass), and the weight again permitted to rest upon it.
35 I also in some cases, for the purpose of raising the coal receiver above described, construct a cylinder of brass or other suitable metal of such length and diameter that the piston thereof when pressed with a certain hydrostatic pressure will be sufficiently powerful to raise the coal receiver when filled with coal; the said hydrostatic pressure I calculate from the most conveniently

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accessible height I can place a small cistern of water or other suitable fluid in or connected with the premises in which the coal feeder is intended to operate. To the said piston, which is made accurately to fit the said cylinder, and provided with a leather packing, I attach a rod, which passing through the top of the cylinder, in which it is also made tight by a leather collar, is connected to a chain, which hanging over a pulley or pullies, is at its other extremity fastened to the said coal receiver. To the upper end of the cylinder I attach a small metallic pipe passing in the most convenient way to the said elevated cistern, which I supply with water by manual labour or by any other suitable means. Upon the said pipe at some easily accessible place I fix a small cork with an index finely graduated, by which the admission of the fluid into the cylinder is regulated, and of course the rate of the time of the elevation of the receiver and discharge of the coal also regulated; the piston being depressed and the cylinder filled with water, the said small cock is shut, and another pipe, which I call the exit pipe, attached also to the upper end of the cylinder, but passing downward to convey the water into some convenient place, and having a cock upon it, is opened, and the water is discharged by the preponderating weight of the receiver, which will lower itself and likewise draw up the piston preparatory to another action. With my said improved or peristaltic grates the smallest coal may be used; but pieces of coal larger than would pass through in every direction a ring of four inches diameter must be broken before they are put into the hopper or into the coal receiver. I have already intimated and I wish it to be clearly understood, that the improvements which form the subject of the present Specification do not consist in the invention or construction of the fire feeder, which, with the exception of the sliding bottom plate thereof moving through equal spaces at each end, is already described in my Specification of the Invention for which I obtained His Majesty's Royal Letters Patent, dated the Twenty-ninth day of June, in the year One thousand eight hundred and nineteen, for "Certain Improvements in Steam Engines, and the Furnaces of Steam Engines, by which a Saving in the Consumption of Coal is effected, and the Combustion of Smoke is more completely attained," though I have thought it advisable for the sake of perspicuity to repeat here many parts of the description given in the Specification alluded to, nor do the improvements which form the subject of the present Specification consist in inclining the grate bars, which is not new, nor in the feeding hole in the roof of the furnace, nor in the invention or construction of the cylinder and piston pressed with a column of water, by which the coal receiver is discharged. But the improvements which form the subject of the present Specification consist, first, in the means, that is, the motion communicated to the grate bars which I now employ and have before

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described, by which the fire is progressively conveyed through the furnace, and the clinkers and other incombustible matter deposited in a close receptacle, constituting what I designate a peristaltic grate, and which I apply to the furnaces for steam boilers, coppers for brewing, stills and evaporating vessels, to
 5 reverberatory furnaces for melting or refining metals, to furnaces for heating gas-retorts, to furnaces for stoves or ovens for annealing glass or cast iron, or to any furnace to which the said peristaltic grate is applicable; and, secondly, in introducing coal by means of the coal receiver described before upon my said peristaltic grates or other grates to which the same may be applicable, and
 10 regulating the same by means of the said sand regulator, or the said hydrostatic cylinder and piston already described.

In witness whereof, I, the said William Brunton, have hereunto set my hand and seal, this Twenty-third day of December, in the year of our Lord One thousand eight hundred and twenty-two.

15

WILLIAM (L.S.) BRUNTON.

This deed was signed, sealed, and delivered, taken and acknowledged, by the within-named William Brunton, at Birmingham, in the
 20 County of Warwick, this Twenty-third day of December, in the year of our Lord One thousand eight hundred and twenty-two, before me,

25

THO^s EYRE LEE,

A Master Extraordinary in Chancery.

AND BE IT REMEMBERED, that on the Twenty-third day of December, in the year of our Lord 1822, the aforesaid William Brunton came before our said Lord the King in His Chancery, and acknowledged the Specification afore-
 30 said, and all and every thing therein contained and specified, in form above written. And also the Specification aforesaid was stamped according to the tenor of the Statute made for that purpose.

Inrolled the Twenty-sixth day of December, in the year of our Lord One thousand eight hundred and twenty-two.

LONDON :

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